ONSLOW COUNTY

HURRICANE RESPONSE PLAN

JANUARY, 1984

Prepared at the Direction of

Onslow County Office of Emergency Management

and

Onslow County Board of Commissioners

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ONSLOW COUNTY HURRICANE RESPONSE PLAN

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RECORD OF CHANGES

CHANGE NUMBER	DATE OF CHANGE	DATE ENTERED	CHANGE MADE BY (SIGNATURE)

ONSLOW COUNTY HURRICANE RESPONSE PLAN

I. AUTHORITIES

A. North Carolina General Statutes, Chapter 166.

B. Civil Preparedness Resolution for Jacksonville-Onslow.

II. REFERENCES

A. North Carolina Disaster Relief and Assistance Plan (NCDR&AP)

B. Jacksonville-Onslow Disaster Operations Plan.

C. Jacksonville-Onslow - American National Red Cross Agreement.

III. PURPOSE AND SCOPE

A. Purpose: This Plan has been developed to provide for an orderly and coordinated evacuation of endangered areas to minimize the effects of hurricanes on residents and visitors in Onslow County. The Plan provides for the alerting of selected officials, the evacuation of the public from danger areas, and designation of shelters for evacuees. It also provides for reentry into evacuated areas when the threat to persons is ended.

B. Scope: This Hurricane Evacuation Plan is a single-purpose contingency plan and is a part of an all encompassing local disaster operation plan which specifies functional emergency responsibilities (reference II.B.).

IV. ORGANIZATION

A. Evacuation Action: Hurricane evacuation involves all areas under County jurisdiction and Municipal jurisdiction. As joint action is required by County and Municipal governments, a joint organization for decision making and use of resources is needed. A Control Group and a Support Group are hereby established for this purpose.

B. Control Group:

1. Mission: To exercise overall direction and control of hurricane evacuation operations including decisions to institute county-wide increased readiness conditions and such other actions deemed necessary in response to the situation.

2. Composition:

a. The Chairman of the County Board of Commissioners - Group Chairman.

b. The Mayors (or their representatives) of:

(1) Jacksonville
(2) Swansboro
(3) Holly Ridge
(4) Richlands

c. County Emergency Management Coordinator - Advisor.

3. Line of Succession: In the event that any of the members of the Control Group are not available, each primary member will be succeeded by alternates who will have the responsibility and authority of the primary member (see Attachment 1).

C. Support Group:

1. Mission: To provide personnel and material resources for the implementation of preplanned actions and actions as directed by the Control Group; to provide direction to personnel engaged in operations; and to provide information, data, and recommendations to the Control Group.

2. Composition:

a. County Manager - Group Chief
b. Sheriff
c. Director of Social Services
d. Superintendent of Schools
e. County Health Director
f. County Auditor
g. County Tax Assessor
h. County Fire Marshal
i. Public Information Officer
j. Rescue Squad Representation
k. State Highway Patrol Liaison Officer
l. Red Cross Liaison Officer
m. Jacksonville City Manager
n. Communications

D. Operational Locations: The Control and Support Groups will be located in the Emergency Operating Center (EOC) Agriculture Building to facilitate coordination. Should it become necessary to move the groups to an alternate EOC location, the new location will be the Carolina Telephone and Telegraph Office.

V. CONCEPT OF OPERATIONS

The Onslow County concept for hurricane evacuation calls for:

A. Early alerting of officials and concerned agencies in the entire County.

B. Overall direction and decision making by a Control Group.

C. Increased readiness actions taken progressively as the hurricane approaches and as the threat of injury and damage increases.

D. Evacuation of residents and visitors on beaches and in threatened low-lying areas upon decision of the Control Group.

E. Movement of evacuees to designated and operating public shelters, or out of Onslow County and the threatened area.

F. Mass care for evacuees in predesignated shelters in accordance with agreements.

G. Reentry of evacuees to evacuated areas when authorized by the Control Group and when the hurricane threat has passed or damage assessments indicate that reentry is feasible.

H. Local governments request State and/or Federal assistance, as necessary, before or after a hurricane (see NCDR&AP, Annexes D, E, F and G).

VI. WARNING AND ALERT SYSTEM

The system for dissemination of hurricane watches and warnings and for notification of departments and populace that the evacuation plan will be executed, is shown as a flow chart (see Attachment 2).

VII. INCREASED READINESS ACTION CHECKLIST

(See Attachment 3 - Checklist and Attachment 4 - Condition/ Action Flow Chart).

A. Readiness Conditions: The following increased readiness conditions are established:

Condition 5	Hurricane Season (June 1 - November 30)
Condition 4	Alert - Hurricane Advisory
Condition 3	Hurricane Watch - Approximately 48 hours to forcasted landfall

Condition 2	Hurricane Warning - Approximately 24 hours to forcasted landfall
Condition 1	Twelve hours or less to forecasted landfall
Condition 0	Landfall
Reentry	Threat removed or damage assessment allows

B. The Control Group will declare the condition. The Support Group will implement actions for each condition when announced.

VIII. EVACUATION AREAS, ROUTES AND SHELTER LOCATIONS

(See Attachment 5).

A. General:

1. Evacuation routes and designated shelters for beach areas are as indicated on Attachment 5.

2. Other residents wishing to seek shelter (mobile home residents or persons living in any structure which does not provide adequate protection) should go to the nearest designated shelter.

B. Shelter:

1. A shelter is defined as a predesignated structure of sufficient strength to withstand high winds, which is located in an area not subject to flooding or storm surge and which will safeguard a given number of evacuees.

2. Onslow County is responsible for providing shelter for all residents and visitors in Onslow County. Onslow County will also provide shelter for residents of Pender or other surrounding counties to the maximum extent possible.

3. Shelters will be operated by the Onslow County Chapter of the American National Red Cross supplemented by school system personnel if needed as per agreement (reference II.C).

4. Shelters will be opened only on an as-needed basis. Locations of operating shelters will be announced on local radio stations.

5. Evacuees will be instructed to bring blankets, light sleeping cots, battery operated radios, flashlights, and special medicinal and dietary needs (including baby needs) for the duration of the shelter period.

6. Persons living on West Onslow Beach may take shelter in Topsail High School or Topsail Elementary School in Pender County if they so desire.

IX. REENTRY

A. Upon cancellation of all hurricane warnings and watches which include Onslow County and when no damage has been experienced, the Control Group will authorize reentry to all evacuated areas.

B. When hurricane damages have resulted, reentry to evacuated areas will be based upon damage assessments in any rescue or other relief operations in progress. Reentry will be authorized by Control Group to specific evacuated areas and under conditions specified.

C. Decisions of the Control Group will be broadcast by the P.I.O.

X. RESPONSIBILITIES

A. Local:

1. Control Group: Overall direction (as directed in Paragraph IV.B).

2. Support Group: As shown in responsibility blocks on the Increased Readiness Action Checklist, Attachment 3.

3. County Emergency Management Coordinator:

a. Serves as advisor to the Control Group.

b. Coordinates actions of the Support Group and operations involving local nongovernment organizations and operations of forces from outside the County.

c. Operates the County EOC.

d. Furnishes Situation Reports to the State EOC.

e. Developes and conducts exercises to test and evaluate this Plan.

B. State and Federal Agencies:

1. National Weather Service: Provides hurricane watches, warnings, and related weather information.

2. U.S. Coast Guard:

a. Provides warnings to ships and boats in affected coastal areas.

b. Assists in coastal evacuation upon request.

3. Commander, Marine Corps Base, Camp Lejeune - Commander, Marine Corps Air Station: Maintains liaison and coordinates actions with County EOC.

4. State Highway Patrol:

a. Operates State Warning Point and passes weather information via Police Information Network (PIN).

b. Responsible for traffic control on State Highway Systems.

5. State Division of Emergency Management:

a. Receives requests for assistance, coordinates State actions, and arranges for assistance from Federal agencies.

b. Area "C" Emergency Management Coordinator:

(1) Assists in coordination of evacuation efforts.

(2) Assists in coordination of State assistance.

XI. COMMUNICATIONS

A. Communications will be in accordance with Annex B, NCDR&AP and appropriate local plans.

B. The Sheriff operates the County Severe Weather Warning System and Traffic Control Points.

C. The Communications Officer will insure communications between the Control and Support Groups and shelters.

XII. PUBLIC INFORMATION

A. The Public Information Officer (PIO) will provide information to the public via the news media and otherwise based upon decisions of the Control Group to include the following:

1. Precautionary/preparatory measures recommended for the public.

2. Evacuation instructions.

3. Reentry instructions.

4. Damage information.

B. Warnings to the public are disseminated by the news media (radio, TV and newspapers), from National Weather Service Bulletins, and advisories and statements as received directly and as provided through the warning system.

XIII. EXERCISES

An exercise will be conducted annually to test and evaulate this Plan.

XIV. APPROVAL

Submitted:

This Plan is Approved by the Undersigned:

Emergency Management Coordinator	Onslow County Board of Commissioners
Mayor, Jacksonville, N.C.	Mayor, Holly Ridge, N.C.
Mayor, Swansboro, N.C.	Mayor, Richlands, N.C.

ATTACHMENT NO. 1

CONTROL GROUP

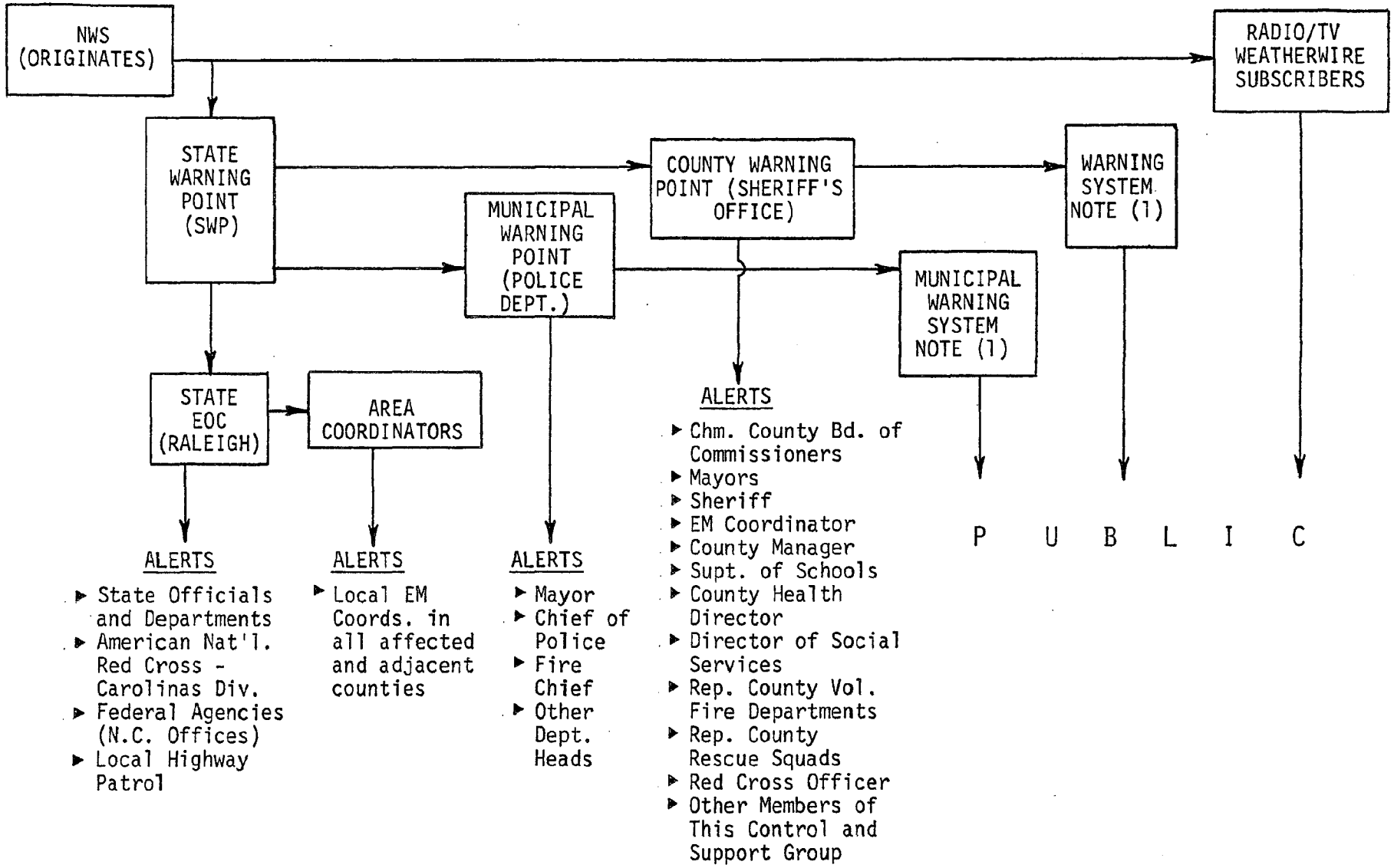
LINE OF SUCCESSION

To assure continuity of responsibility for governmental functions of direction and control of emergency operational efforts, the following lines of succession to offices are established:

1.	Chairman of the Onslow County Board	a.	Vice Chairman	b.	In the absence the Chairman and Vice Chairman, the members present may choose a temporary chairman
2.	Mayor of Jacksonville	a.	Mayor Pro Tempore	b.	The next senior member of the council
3.	Mayor of Swansboro	a.	The Town Commissioner that received the most votes	b.	The Chief of Police
4.	Mayor of Holly Ridge	a.	Mayor Pro Tempore	b.	Present Town Commissioners elect temporary mayor
5.	Mayor of Richlands	a.	Mayor Pro Tempore	b.	Town councilman receiving the largest vote count
6.	Emergency Management Coordinator	a.	Operations Chief	b.	Communications Chief

ATTACHMENT NO. 2

WARNING AND ALERTING FLOW CHART



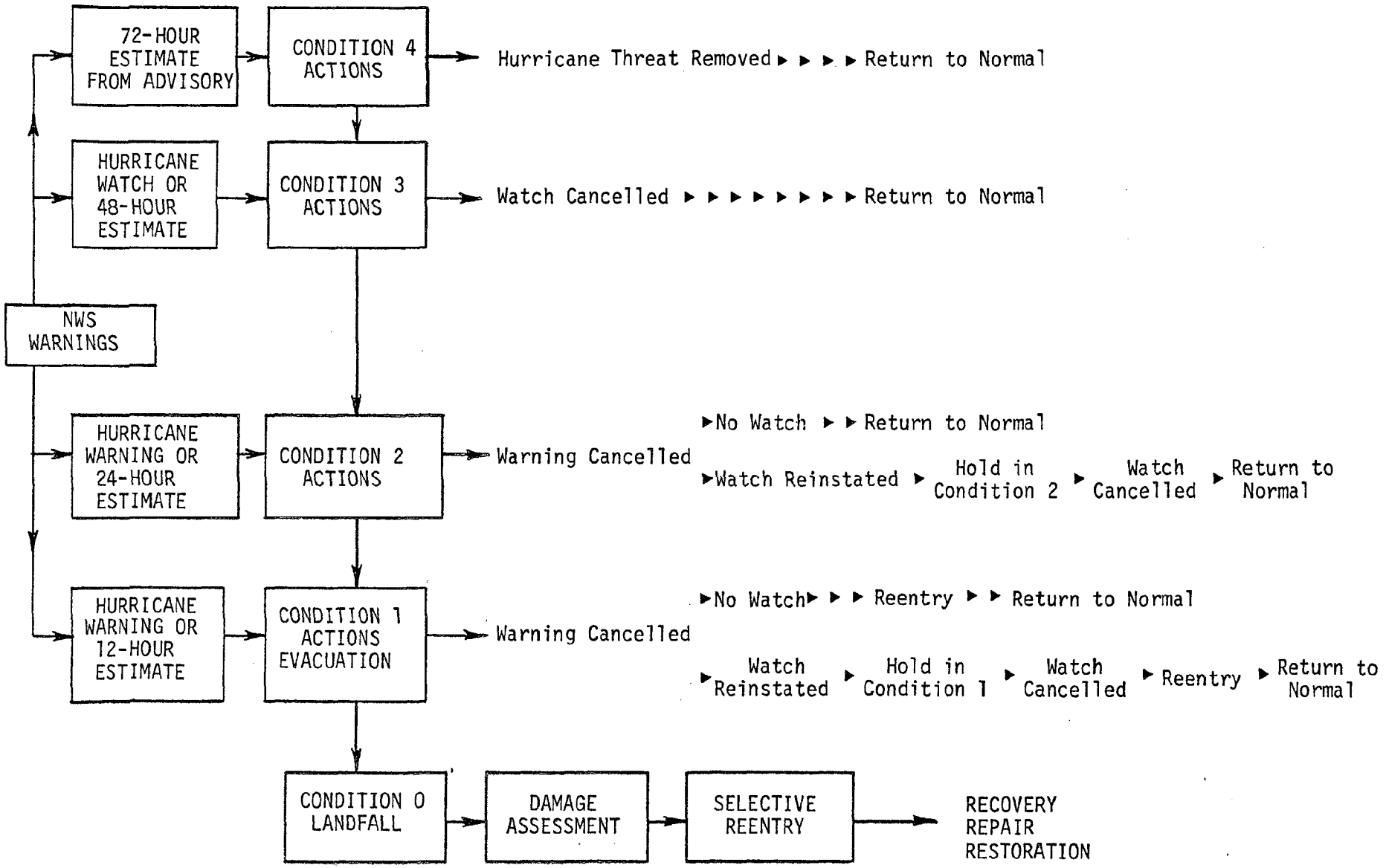
NOTE (1) County and municipal warning systems disseminate warnings to the public by use of radio/TV bulletins, newspaper extras, handbills, signs, loud speaker or other aural systems, and door-to-door. Law enforcement, rescue squads and volunteer citizens' organizations used to spread warnings when activated by control group.

AGENC P I O	COUNTY FIRE MARSHAL	CHEF OF COUNTY RESCUE SQUAD OR OTHER RESCUE SQUAD OFFICIAL	AMERICAN NATIONAL RED CROSS LOCAL CHAPTER
bilities: e or approve all releases. INCREASED READINESS ACTION	Responsibilities: - Coordinate fire fighting suport throughout the County (paid and volunteer). - Assist sheriff upon request.	Responsibilities: - Coordinate provision of rescue support operation. - Provide ambulance service to transport nonambulatory persons.	Responsibilities: - Operate designated Red Cross shelters. - Provide other Red Cross assistance.
CONDITIC BEGINNIN HURRICANE	imination to public icane safety rules shelter locations.		
CONDITIC 72 HO ALERC	inue dissimination he above.		
CONDITIC iminate special ructions to lids. 48 HOUR HURRICANE	1. Gas up all vehicles. 2. Check all equipment.	1. Gas up all vehicles. 2. Check all equipment.	1. Make initial contact with superintendent of schools on using existing schools as shelters as planned. 2. Designate and assign personnel to specific shelters.
lerate Condition 4. CONDITIO 24 HOURS HURRICANE W	1. Mobilize personnel. 2. Render assistance as requested. 3. Coordinate fire fighting activities. 4. Assign representative to EOC.	1. Mobilize personnel. 2. Move nonambulatory personnel. 3. Coordinate rescue operations. 4. Assign representative to EOC. 5. Provide other assistance as requested.	1. Mobilize personnel. 2. Brief shelter managers. 3. Conduct joint inventory of shelters with school officials. 4. Representative man EOC. 5. Upon EOC direction, open and operate shelters. 6. Keep EOC informed of shelter situation.
inue dissimination CONDITIOshelter location on uation routes. 12 HOURS OR EVACUATI			
iminate special CONDITIOructions from rol Group. "LAND FA			
ase notices of ged areas, etc., reentry instruc- REENTRYns.			1. Operate shelters as long as necessary. 2. Render assistance to needy persons.

ATTACHMENT NO. 3

ATTACHMENT NO. 4

CONDITIONS/ACTIONS FLOW CHART



ATTACHMENT NO. 5

EVAUCATION AREAS, ROUTES, AND SHELTER LOCATIONS - MAP

(Note: Also see Attachment 5A - Hurricane Evacuation Plan, following)

ATTACHMENT 5A

HURRICANE EVACUATION PLAN

I. GENERAL

Certain areas of Onslow County can be termed high risk areas and should be evacuated prior to the time a hurricane strikes. The most vulnerable areas are the barrier islands (beach areas) and low lying areas adjacent to the sounds and marshes between the barrier islands and the mainland. The only developed beach community in the County is West Onslow Beach and most of the attention relative to the evacuation of residents or occupants must concentrate on this highly vulnerable area. Attention must also be given to sound front developed areas and communities such as Sneads Ferry and Swansboro; however, multiple evacuation routes are generally available and the areas are relatively accessible to high ground.

Other areas, such as portions of the City of Jacksonville are flood prone, (either from rising water or high rainfall runoff), and limited evacuation of these areas may be required. Camp LeJeune is also subject to similar flooding problems in some areas, but local military authorities will manage this problem within this own resources; however, close coordination should be effected between Onslow County and U.S. Marine Corps Base authorities.

II. EVACUATION PLAN

The general plan for evacuation of threatened areas of the County are briefly summarized in the Onslow County Hurricane Evacuation Plan (Attachment No. 5 of the Onslow County Hurricane Response Plan). This single page flyer is attached hereto and is also available for widespread distribution to interested and/or affected citizens throughout the County. The circumstances requiring evacuation, evacuation routes and emergency shelters are clearly depicted on the plan.

III. EVACUATION CONSIDERATIONS

As mentioned above, evacuation of County areas other than the barrier island beaches does not appear to represent a difficult problem. Some access roads are low-lying and persons living below approximately six (6) feet above mean sea level (m.s.l.) should seek higher ground before flood tides reach that level. The Swansboro, Sneads Ferry and intervening low-lying mainland areas fall in this category. Generally, evacuation of these areas three (3) to five (5) hours before a storm is scheduled to strike the mainland should provide adequate lead time for safe evacuation of these areas. Development densities in these areas is low, so

traffic flow or road conjestion should not represent a problem. Persons living in these areas should be prepared to evacuate on short notice when Condition 1 is announced.

The barrier island (beach) areas are an entirely different situation. Access routes are restricted and in some cases inferior. Although the Onslow County coastline is fairly long (approximately 27 miles), less than half of this (about 12 miles) is developed or inhabited by permanent or seasonal residents. The Hammocks Beach State Park island is undeveloped and should be evacuated and closed completely during a threatened hurricane storm period. The coastline within the Camp LeJeune Marine Base is under the jurisdiction of military authorities. Thus, the primary area requiring careful evacuation planning is West Onslow Beach. The remainder of this discussion focuses on that area.

IV. EVACUATION TIMES ANALYSIS[1./]

The amount of time it takes to safely evacuate an area depends on the level of development and number of people in the area at any one time. It depends on the condition of roads and bridges along the evacuation route. It also depends on the attitudes of local residents and visitors and the strength of a particular storm.

Evacuation time has four components: mobilization time, travel time, queuing delay time, and pre-landfall hazards time.

Mobilization time is that period between the issuance of the evacuation order and the departure time of the last vehicle from the vulnerable area. It depends to a large extent on the attitudes and response time of residents. Travel time is the period necessary for the vehicles to travel the length of the evacuation route at an anticipated operating speed assuming no traffic delays (queuing). Queuing delay time is defined as the time spent by vehicles in traffic jams resulting when the capacities of the evacuation routes are exceeded by the number of vehicles entering those routes.

1./ William D. McElyea, David J. Brower, David R. Godschalk. Before the Storm; Management Development to Reduce Hurricane Damages. Ocean and Coastal Ecology Program Center for Urban and Regional Studies, UNC/Chapel Hill; August 1982.

Mobilization time, travel time, and queuing delay time together consititute the community's "clearance time" -- the total time needed to move all evacuees to temporary shelter once an evacuation order is issued. Pre-landfall hazards time is the time before the eye of the hurricane reaches the community when the storm surge or sustained high winds render evacuation routes impassable. The National Hurricane Center issues warnings based on its predictions of the time the eye is expected to reach land. However, the storm surge and sustained winds can strike the community hours before the eye does. This pre-landfall hazards time cannot be used for safely moving evacuees; it is greater for more intense storms.

Estimating these various components of evacuation time remains a complicated task due to uncertainty regarding the intensity, timing, and other characteristics of any particular storm and uncertainty regarding the willingness of local residents and visitors to evacuate. Current estimation techniques involve:

1. estimating storm surge levels, wind speeds, and their time of arrival before the eye's landfall for storms of different intensities;

2. identifying points along the evacuation route that are subject to flooding;

3. estimating the total number of people and automobiles that must be evaucated;

4. estimating the carrying capacity of roads along the evacuation route;

5. identifying any bottlenecks or other points along the route that could delay traffic;

6. estimating the timing of traffic movement and traffic levels along the route; and,

7. estimating the time it will take people to respond to an evacuation order.

Much of the evacuation time needed boils down to the level of development, resident population, and visitor population in areas that need to be evacuated, relative to the carrying capacity of the evacuation route. If the level of development of high hazard areas exceeds the route's capacity for safe and timely evacuation, the community can expect to suffer numerous casualties during a major storm. Local officials should bear in mind that the National Hurricane Center's hurricane warnings (usually used as the signal to evacuate) are issued 12 hours before the eye is

expected to hit land. Flooding and hurricane-strength winds can precede the landfall by several hours, depending on the storm's size and intensity.

The Planning and Research Branch of the North Carolina Department of Transportation (DOT), (Larry R. Goode), prepared an internal memorandum for evacuation of Onslow and Pender Counties (beach communities). A copy of this memo is attached hereto as Appendix A. This brief study estimates an evacuation time of 7 to 9 hours for the beach complex of Topsail (Ashe) Island. The primary problem relative to the West Onslow Beach area is that the analysis credits only 1,300 people evacuating northward from the area over N.C. Highway 210. Never-the-less, the analysis gives indication of the extended time required to evacuate the area.

Evacuation time estimating techniques are further refined by John R. Stone in his U.N.C. sea grant working paper 83-2 entitled "Hurricane Emergency Planning: Estimating Evacuation Times for Non-Metropolitan Coastal Communities."[2./] This excellent analysis closely parallels but refines the DOT estimate approach referenced above. It also provides a short cut calculation method for simple evacuation networks like West Onslow Beach. Textural references and the evacuation time calculating technique in the following subparagraphs are borrowed from Stone's works.

West Onslow Beach Evacuation Time Estimate

A. Evacuation Area: West Onslow Beach is a barrier island which forms the southeastern border of Onslow County facing the Atlantic Ocean. Elevations range from 0 to a little over 20 feet m.s.l. at its highest point. The width ranges from less than one quarter to just over one half mile. The area lies entirely within the hurricane flood zone. There is a single two lane road (N.C. Highway) running north to south over the entire length of the island. It is connected to the mainland by a relatively new high level fixed span two lane bridge about four miles from the north end of the island (New River Inlet). Route 210 also extends southward (through Surf City) with connections to the mainland over a two lane swing bridge at an elevation of about 14 feet above the Atlantic

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2./ Also included as reference 11/ in a report to the Onslow County Board of Commisioners entited: Hurricane Storm Mitigation and Post-Disaster Reconstruction Plans for Onslow County, North Carolina (January 1984), by Henry von Oesen and Associates, Inc.

Intracoastal Waterway (AIWW). For several reasons, it is recommended that all West Onslow Beach traffic evacuate northward as shown on the evacuation plan map.

B. Hurricane Scenario: In 1954, when Hurricane Hazel hit North Carolina, a high-water mark from the tidal surge (excluding wave action) of 16 feet above mean sea level was recorded at the South Brunswick County region. This is the surge expected from a Category 4 storm which could similarly effect the Topsail Island area. A storm of this magnitude could be expected there roughly once every 100 years. Assuming the hurricane eye from such a storm crossed over West Onslow Beach, it is likely that nearly 90 percent of the flood zone would be flooded. The possibility of flooding will be increased by the likelihood of torrential rains and the primary evacuation route would be completely inundated.

C. Hazards Time: A complete analysis for the surge and gale-force wind hazards time components of evacuation time would require a computer simulation of the storm. However, prior detailed analysis descriptions of a Category 4 storm suggest that low-lying escape routes may be cut by rising water as early as three to five hours before the hurricane eye arrives. This estimate for roadway inundation time is consistent with a storm which moves at a typical 10 mph forward speed and has a surge that extends about 30 miles out from the hurricane eye.

An investigation and inspection of the evacuation route (NC Highway 210) reveals that portions of the road are at elevations of about 6 to 7 feet above mean seal level. Fortuitously, the lowest points are at the southern boundary (at the Surf City north limit) and along much of highly developed north end of the beach area between the bridge crossing point and New River Inlet. In many areas, the road passes extremely close to the ocean (where low dunes may or may not exist), which further increases the roads vulnerability to tide and wave attack. Finally, the immediate approach road section to the high level bridge crossing is at an elevation below 8 feet m.s.l. Thus, the escape access to the bridge itself could be inundated relatively early in the storm period. The excellent new high level bridge represents no inpediment to rapid evacuation of controlled vehicular traffic.

Gale force winds and blinding rain can also combine to make it virtually impossible to drive a vehicle on the evacuation route. Wind analysis for barrier islands and coastal areas in Florida suggest that gale-force winds may precede landfall of the eye by as much as six hours.

Based on the above, a cut-off time of 3 to 5 hours is used in preparing this estimate.

D. Mobilization Time: As previously mentioned, mobilization time for a community may vary somewhat. However, actual data suggests that it may take over five hours for everyone to begin the evcuation. A value of three to four hours would find 80 percent to 90 percent of the evacuees on their way and is used in this analysis.

E. Travel Time: Evacuation travel is based on the length of the evacuation route and the assumed uninterrupted operating speed of the evacuation vehicles. Assuming an evacuee lives at the southern end of NC 210 on West Onslow Beach (at Surf City Town limits), he or she must travel six and one half (6-1/2) miles to reach the bridge. It is another seven miles to Dixon School (recommended shelter), giving a total evacuation distance of about 14 miles. Assuming storm conditions and evcuation traffic, yet uninterrupted travel, an average operating speed of 35 mph could be maintained on the two-way, two-lane rural roads of the evacuation area. The "free-flow" travel time is, therefore:

Travel Time = Distance/Speed
= 14 miles/35 mph
= 0.40 hours
= 24 minutes

This estimate does not include queuing delay which is determined below.

F. Queuing Time Delay: It is anticipated that all of the evacuees will originate on West Onslow Beach. It is possible that some occupants of Surf City and Topsail Beach to the south may opt to attempt to evacuate northward over Route 210 through West Onslow Beach; however, this should be discouraged and evacuees from those communities should continue to exit the area over the swing span bridge and N.C. Highway 50 that serves these communities. Additionally, Highway 210 may be flooded early in the vicinity north of the Surf City Town limits as previously mentioned.

The primary constraint to rapid evacuation of West Onslow Beach residents and visitors is the limited carrying capacity of the principal evacuation route, N.C. Highway 210. As mentioned in paragraph C above, extensive portions of this road are at elevations as low as 6 feet m.s.l. and consequently may become impassable during early tide surge and gale conditions that may exist several hours before the hurricane makes a landfall. This coupled with the marginal

condition of the road will influence queuing delay times for the area.

The Onslow County Land Use Plan projects a maximum population density of West Onslow Beach in 1990 of 10,335 people. Based on the rapid growth experienced in the area in the past five years, this projection is considered to be quite low; however, for purposes of this analysis, a peak population of 10,000 is used.

In order to estimate the queuing delay time during a particular time period of the evacuation, the traffic demand and the restrictive road capacity must be known. For the purposes of this analysis, the following will be assumed:

1. 10,000 persons evacuate.
2. The average automobile occupancy is 2.5 persons per vehicle.
3. 20 percent of the evacuees leave before the order is given.
4. The remaining 80 pecent of the evacuees leave over a 3.5 hour period.
5. Traffic control officers will be stationed at intersections thereby mitigating the usual intersection capacity constraints.
6. Intersection turning traffic is negligible compared to the evacuation traffic.
7. Traffic moves at "level of service D to E," with one lane for evacuation and one lane for emergency vehicles.

The evacuation rate or traffic demand is thus,

Evacuation Traffic Demand = (No. of evacuees/vehicle occupancy) x (1 percent remaining after order) x (1/evacuation period)

or

ETD = (10,000/2.5) (.80) (1/3.5)
= 900 vehicles/hour (3,200 vehicles in 3.5 hours)

Under the planning assumptions outlined above, DOT sources indicate Route 210 should have a carrying capacity about 900 to 1,000 vehicles per hour under optimum conditions; however, the 22-foot width and marginal road condition would reduce this to an assumed ideal capacity of 550 to 825 vehicles per hour. If it is further assumed that under storm conditions, this ideal capacity will be reduced by fluctuation in traffic demand, wind blown debris and winds, it is estimated that the actual evacuation capacity will be only half (50 percent) of the ideal capacity. The road carrying capacity becomes a "bottleneck" in the evacuation process. Thus:

Evacuation Capacity = Ideal capacity x 0.50

Evacuation Capacity = 275 to 400 vehicles per hour (assume 300)

Based on accepted prior study data, the maximum amount of individual vehicular delay is given by the following formula:

Queuing delay time = (Duration of bottleneck) x (1 - Bottleneck capacity/average demand)

Hence,

Queuing delay time = (3.5) (1 - 300/900) = 2 hours

Note: The new high level bridge carrying capacity exceeds the road carrying capacity by a considerable degree and is not considered to be a restricting factor.

G. Total Evacuation Time: The total evacuation time is the summation of the following components:

Cut-off Time	3 - 5 hours
Mobilization Time	3 - 4 hours
Travel Time	0.5 hours
Queuing Delay Time	2 - 3 hours
Total	8 - 13 hours

V. DISCUSSION

As explained in the previously referenced Stone report, the evacuation time estimate of 8 to 13 hours is based on a Category 4 hurricane scenario and is dependent on a number of assumptions. These include the assumed number of evacuees, auto occupancy rate, community response, roadway inundation time, to name but a few.

Changing the assumptions will change the time estimates. It is interesting to note, however, that certain tradeoffs exist. For example, much importance is placed on community awareness and rapid response to evacuation orders. Unfortunately, it is felt that a sensitivity analysis would show that an earlier mobilization of the evacuees will lead to higher traffic demands and more queuing delay. What is gained in response time is lost to traffic delay if bottlenecks exist on the evacuation route.

Looking specifically at the West Onslow estimate of 8 to 13 hours evacuation time, it is seen that the figure is consistent with estimates for roughly similar island situations in Lee County, Florida (7). The estimate is also consistent with the Holden Beach evacuation plan which indicates that evacuation orders will be issued when a hurricane is within 12 hours of landfall.

Finally, further analysis of the future development potential and ultimate development density of West Onslow Beach indicates that the peak summer population could reach well over 30,000 people. This population increase would seriously impact the above estimate and extend projected evacuation times.

APPENDIX A

MEMORANDUM FROM LARRY R. GOODE
PLANNING AND RESEARCH BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION (DOT)

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH 27611

JAMES B. HUNT, JR.
GOVERNOR

WILLIAM R. ROBERSON, JR.
SECRETARY

DIVISION OF HIGHWAYS

March 11, 1983

MEMORANDUM TO: Mr. Gerald Fleming
Safety and Emergency Planning

FROM: Larry R. Goode, Ph.D., P.E.
Project Engineer
Planning and Research Branch

SUBJECT: Peak Season Population Estimates for Onslow and Pender County and Estimated Evacuation Time

Per your request we have made peak season projections for Onslow and Pender Counties based on the number of dwelling units in the area. The peak summer population is approximately 11,300 people.

Based on a peak summer population of 11,300 people, an estimated evacuation time of 7 to 10 hours has been determined. Attached is a report documenting analysis performed in determining peak summer population and total evacuation time.

If you have any questions concerning this matter, please let me know.

LRG/dc

Attachment

cc: Mr. T. L. Waters

ESTIMATED EVACUATION TIME FOR ONSLOW AND PENDER COUNTIES

Evacuation Area

The barrier island beaches off the coast of Onslow and Pender Counties include Topsail Beach, Surf City, Del Mar Beach and West Onslow Beach. The island is a vacation spot for up to 11,300 people during the peak summer season. Elevation on the island ranges from 0 to 22 feet. In the event a Category 4 storm hit the region the island would have to be evacuated. Areas south of Surf City would be evacuated via NC 50. Areas north of Surf City would be routed on NC 210.

Total Evacuation Time

The components of total evacuation time are hazards time, mobilization time, travel time and queuing delay times. The following assumptions are made in this analysis:

1) 11,300 persons to evacuate
   10,000 via NC 50
   1,300 via NC 210

2) Average automobile occupancy is 2.5 persons per vehicle.

3) 20% of the evacuees leave before order is given.

4) The remaining 80% of the evacuees leave over a 3.5 hour period.

5) Traffic control officers will be stationed at intersections, thereby reducing usual intersection capacity constraints.

6) Contra flow traffic is negligible compared to evacuation traffic.

7) Traffic moves at "level of Services D to E".

8) 3% of traffic is recreation vehicles.

9) Two lanes one way on all evacuation routes.

10) Evacuation takes place daylight hours.

Hazards Time

Heavy rain, flooding and gale force winds occurring before the eye of the storm hits may cut evacuation routes. The hazards time component of evacuation time is three to five hours before the eye of the hurricane arrives.

Mobilization Time

It is safe to assume that 80 to 90% of the evacuees will be on their way in three to four hours.

Travel Time

Evacuation travel time is based on the length of the evacuation route with an average "free-flow" operating speed of 35 mph.

Travel time = 20 miles @ 35 mph = .5 hour

Queuing Delay Time

When the evacuation traffic demand exceeds the capacity of the evacuation route a queue will form.

$$\text{Evacuation Traffic Demand (ETD)} = \frac{\text{(Number of evacuees)}}{\text{(Vehicle occupancy)}} \times \text{(\% remaining after order)} \times \text{(1/evacuation period)}$$

$$\text{Capacity} = 2000(\text{number of lanes})(\text{volume to capacity ratio})(\text{lateral clearance factor})(\text{truck factor})$$

Under the assumed conditions the traffic demand will not exceed the capacity of any of the escape routes and there will be no queuing delay.

Total Evacuation Time

Cut Off Time	3-5
Mobilization Time	3.5 hours
Travel Time	.5 hours
Queuing Delay Time	0 hours
Total	7-9 hours

ATTACHMENT 6

JOINT AGREEMENT BETWEEN LOCAL AMERICAN NATIONAL RED CROSS CHAPTERS AND LOCAL EMERGENCY SERVICES/CIVIL PREPAREDNESS ORGANIZATIONS
JOINT OPERATING AGREEMENT

Between

ONSLOW COUNTY
(Chapter)

of the

AMERICAN NATIONAL RED CROSS

and the

COUNTY OF ONSLOW
(Political Subdivision)

STATE OF NORTH CAROLINA

Relating to Natural Disasters

I. PURPOSE

This operating arrangement describes the respective responsibilities and roles of the Onslow County Chapter of the American National Red Cross (hereinafter referred to as ANRC) and the County of Onslow, State of North Carolina in preparedness plans and operations for natural disaster emergency services. Through collaboration, the resources of the ANRC and the County of Onslow are brought to bear for the relief of persons affected by natural disasters or other emergencies.

II. RESPONSIBILITIES IN NATURAL DISASTERS

A. The American National Red Cross. The act of Congress constituting the Red Cross chapter required the Red Cross to undertake relief activities for the purpose of mitigating suffering caused by disaster and obligates the Red Cross to develop and carry out measures to prevent such suffering. Public Law 93-288 in no way affects the legal status nor restricts the authority and purposes of the American National Red Cross as set forth in that ACT. In carrying out the purposes of Public Law 93-288, and Sec. 303, (b), (3), or subsequent disaster legislation, Federal, state or local government may, by contract or otherwise, accept and utilize the services and facilities of the Red Cross, or may render through the Red Cross any assistance authorized by that Act, such as medicines, food, and other consumable supplies or emergency assistance.

Aid to disaster victims is not dependent upon a Presidential declaration of a major disaster, but is provided regardless of the size of that catastrophe or the number of people involved. Through a program of disaster preparedness and relief by ANRC chapters, divisions, and areas throughout the Country, ANRC provides disaster victims with food, clothing, shelter, first aid, and supplementary medical, nursing, and hospital care and meets other urgent immediate needs. This help may be provided on the bases of mass care in shelters and at feeding stations and aid stations and also provides food and first aid services for emergency workers. The Red Cross provides blood and blood products for disaster victims, and handles inquiries from concerned individuals outside the disaster area.

Help for disaster victims may also be provided on an individual family basis, with funds or purchase orders issued to families for food, clothing, medical care, health items, essential household furnishings, urgently needed occupational supplies and equipment, emergency rentals for housing, transportation and temporary minor repairs to homes so that they can be reoccupied. The Red Cross will assist in providing information and federal and other resources available for additional assistance to disaster victims and will refer families to such resources. The Red Cross will assist families in assembling needed information for applications for such aid and will help them in processing their applications if the families ask for such assistance. When there is no Presidential Declaration of a major disaster, or when such declaration has been made but a family is not eligible for government benefits, Red Cross assistance may also include other recovery needs in addition to the emergency help already given. In such cases, the need for help will be determined by the individual casework process. All Red Cross disaster aid is on a grant basis, with no request for or expectation of repayment.

Because administrative responsibility and financial control are inseparable, the Red Cross requires that all funds utilized by it in extending relief will be expended in accordance with its established policies.

B. Government:

1. The maintenance or restoration of normal government services and facilities.

2. The extension or augmentation of certain normal government services when such extensions or augmentation is consistent or compatible with such normal community services. These services include:

a. Warning and evacuation.

b. Search and rescue.

c. Police and fire protection.

d. Emergency medical, public health, and sanitation.

e. Identification and disposition of the dead, including operation of temporary morgues.

f. Institutional care for the sick, aged, and orphaned.

g. Survey and damage assessment.

h. Engineering and public work.

i. Designation of hazardous structures and area.

j. Debris removal from public property.

k. Public welfare.

l. Utilities.

m. Supply, transportation, and communications.

n. Manpower.

o. Immediate notification to all departments and agencies providing assistance when a disaster is imminent or occuring.

p. Coordination and determination of priorities in allocation and use of available local resources and requests for support through other government or private agency channels.

C. Red Cross Relations With The Federal Disaster Assistance Administration, State and Local Governments:

1. The Red Cross will usually have on-going working relationships for disaster preparedness and relief with state and local governments. Because the Red Cross responds immediately following a disaster's occurence, the organization will often be operational before a Presidential Declaration of a major disaster is made and will be working with the state and local governments before a FCO (Federal Coordinating Officer) of FDAA is designated. While the Red Cross will keep

the FCO fully informed as to the working arrangements involved in a specific disaster situation, the ANRC will continue its direct relationships with the state and local governments.

2. FDAA Disaster Assistance Centers. The Red Cross will provide appropriate volunteers and/or staff to give direct service to disaster victims at all FDAA disaster assistance centers when they are established. However, if the Red Cross has opened disaster service centers in the disaster area prior to a Presidential Declaration and/or prior to the opening of FDAA Centers, the Red Cross will continue to operate as many of its separate centers as necessary unless facilities and convenience to disaster victims are adequate in the FDAA center to accomodate the number of Red Cross relief personnel and disaster victims involved

III. COOPERATION AND COORDINATION WITH PUBLIC AUTHORITIES

The Red Cross cooperates with all federal, state and local agencies who have any responsibilty for rendering disaster relief assistance to the disaster victims. The Red Cross is willing to accept commissions from governments and coordinate its relief effort with designated agencies. This may include acting as Agent for governmental units under mutually agreed upon conditions.

SIGNATORY:

Coordinator of Civil Preparedness Emergency Operations	ARC Chapter Chairman
Date Approved	Date Approved